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NAVY AUTOMATED FOOD SERVICE RECORDS MANAGEMENT AND CONTROL SYSTEM

BY

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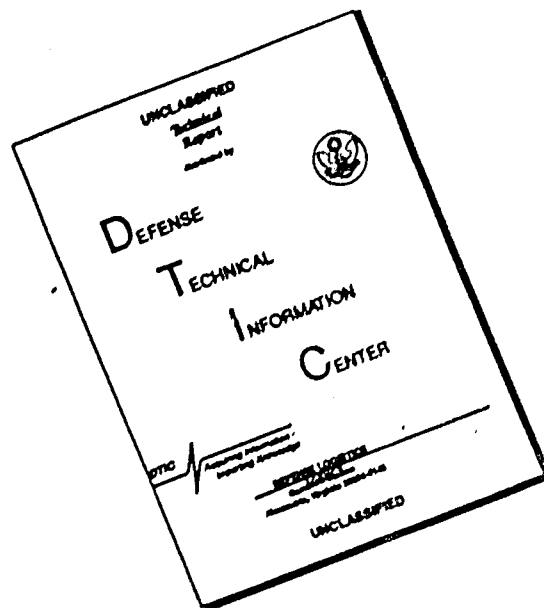FINAL REPORT NOVEMBER 1978 TO SEPTEMBER 1984

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19 ABSTRACT (Continue on reverse if necessary and identify by block number)
The Advanced Systems Concepts Directorate (ASCD), formerly the Directorate for Systems Analysis and Concept Development (DSACD), designed and developed an automated management information system for US Navy Food Service Operations. The system was designed for Enlisted Dining Facilities (EDFs) in the Ashore and Afloat environments. A technology demonstration of this system was conducted in an Ashore environment at NAS Alameda, California for 7 months from 1 July 1983 to 31 January 1984.

The system utilizes state-of-the-art hardware and the High Order Language (HOL) Basic. Natick developed interactive software for the Ashore EDF automated system which incorporated an on-line, real-time communications link for diner validation. In addition, an Afloat EDF automated system was developed which utilized a more sophisticated terminal, CRT, and printer. The Afloat system also required additional software functions for Private Dining Facilities and Stateroom Management. Such a system has already been proven successful in the Ashore environment. The Navy Food Service Systems Office (NAVFSSO) has (cont'd)

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19. Abstract (cont'd)

adopted the Navy Automated Food Service Records (NAFSR) system as the Navy standard for food service operations.

SUMMARY

The Government Accounting Office (GAO) and the Defense Audit Survey (DAS) reports indicate that the lack of management control in food service has been associated with losses exceeding $100 million. To help combat this fraud, waste, and abuse, these reports recommend the automation of military food service. The US Army Natick Research, Development and Engineering Center (NRDEC) was tasked to develop a concept for automating enlisted dining facility records in the Navy, Air Force, and Marine Corps.

The Navy Automated Food Service Records (NAFSR) System was designed not only to automate many time-consuming calculations and report preparation procedures that burden a typical military food service staff but also to tighten the controls on inventory utilization and accountability. In addition, this prototype system tracks which individuals are entitled to subsist at Government expense so that stricter access controls can be applied. The system also provides management with information necessary for an efficient food service operation.

The system is an integration of new technology hardware and NRDEC-developed, state-of-the-art software. The functions that were addressed were Accounting, Menu Production, Inventory Control, Report Preparation/Archiving, Access Control, and File Maintenance. These functions were implemented into two environments: the ashore environment and the afloat environment. In addition to these functions, the afloat implementation addressed the issues of Private Dining Facilities, Stateroom Management, and more sophisticated remote terminal areas.

This system is designed to operate in the new generation of Navy Item Pricing Enlisted Dining Facilities. In this environment, the cash customers pay by the item for food selected. As a result, the microcomputer is linked in real-time to associated electronic cash registers and magnetic stripe card reading devices at the end of the serving lines. These electronic cash registers and card readers provide information regarding which food items have been sold and how much money has been collected from customers. The registers also receive information on whether patrons presenting their magnetic stripe military ID card are, in fact, entitled to receive their meals at Government expense.

The requirements of the particular Navy ashore installation where the Technology Demonstration was conducted dictated that remote electronic data terminals be installed for use by the Food Service Officer, the Records Keeper, and the Leading Mess Specialist. These remote terminals were linked to the main microcomputer via communication cabling for real-time, on-line data transmissions. This communications link provided managers with the capability for careful control of cash collections as well as the verification of entitlement to subsist at Government expense.

In addition, the Navy Automated Food Service Records (NAFSR) concept also provides for very tight controls over the utilization of expensive food product inventories, not only from the point of view of inventory shrinkage through theft but also by more closely matching the amount of food prepared to the

demand for the product. Forecasting algorithms were developed not only for the number of patrons that may be expected at each meal but also for the relative numbers of these patrons that will choose the various items being offered. This projection is used to forecast the required number of servings of each item on the menu as well as the requirements for raw food products needed to prepare the meals.

There is an interface between the meal preparation and the inventory level adjustment based upon how much product has been issued for meal preparation, as well as how much has been received from the commercial vendors and the Navy supply activities. The computer automatically prepares requests for the purchase of more raw food items for the galley when the inventories reach a predetermined low level. Physical inventory forms for use by Mess Management Specialists to perform physical checks of the inventory on-hand are produced by the automated system so that the computer data bases can be verified.

The economic analysis of the NAFSR implementation at NAS Alameda indicated that the NAFSR is cost-effective, resulting in total annual monetary savings of $536,058. This saving was accomplished by tightening access control and inventory control procedures by producing legible, accurate audit trails, and by increasing the productivity of managers by allowing them to spend more time supervising and less time completing paperwork. The Navy Food Service Systems Office (NAVFSSO) has declared the NAFSR system to be the Navy standard for food service and recommended its Navy-wide implementation.

PREFACE

The work outlined in this report describes efforts under Project No. 62724A, Systems Analysis of Navy Automated Food Service Records, during November 1978 through September 1984.

The authors would like to acknowledge the efforts of Mr. Philip Brandler, Director, Directorate for Systems Analysis and Concept Development, who provided invaluable guidance in developing the concepts for Navy Automated Food Service Records (NAFSR).

The authors would also like to acknowledge the very special efforts of two NAVFSSO/NAFSR team members, LCDR Radney Fisher, Chief, Financial Division and MSCM Arthur Salt, Senior Enlisted Advisor to NAVFSSO, whose in-depth knowledge of the manual records system and information flow made this project considerably less difficult. In addition, the authors would like to acknowledge the special efforts of two companies: first, Durango Systems, Inc., with Mr. Robert Varo and Mr. Terry Purcell; and secondly, Data Terminal Systems, Inc., with Mr. Michael Raftery.

The authors would like to recognize the efforts of the following Natick/NAFSR team members: Ms. Jane Benson, Mr. John Keating, Mr. John Tavares, and Mr. Steven Taschereau. Other Natick elements, such as Science and Advanced Technology Directorate (SATD) and Behavioral Sciences Division (BSD), also contributed. Dr. Herbert Meiselman, Dr. Larry Symington, and Captain Gerard Smits assisted in the collection and analysis of pretest and in-test consumer surveys and worker attitude data.

All of these people have exhibited an extraordinary amount of innovation, creativity, and hard work, resulting in the success of this project.

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I. INTRODUCTION

The Department of Defense (DoD) spends more than a billion dollars a year to buy, cook, and serve food at about 2400 dining facilities around the world, as reported in a recent Government Accounting Office (GAO) study. This report indicated that fraud, waste, and abuse could be as much as $100 million each year and recommended automation as a means to reduce these losses.

Natick (NRDEC) developed a Technology Demonstrator to test the feasibility of an automated management control and accounting system. The Navy Enlisted Dining Facility at Naval Air Station (NAS), Alameda, CA, was the test site. The test was conducted from 1 July 1983 through 31 January 1984. The results were so encouraging that the scope of the project was increased to include testing an automated system on the aircraft carrier, USS Constellation (CV-64). This expansion included several modifications in not only hardware configuration but also in the functions the NAFSR addressed. The additional functions were a Stateroom Management Module and a Private Dining Facility Management Module. The test of the automated system designed for the afloat environment was conducted from January 1984 through June 1984.

The NAFSR system not only automates the many time-consuming calculations and report preparation procedures that burden food service personnel, but, more importantly, it makes possible tighter controls on inventory utilization, accountability, and the validation of the identities of those entitled to subsist at Government expense while facilitating the management control necessary for an efficient food service operation.

NAVY FEEDING CONCEPTS

Navy diners may be separated into two distinct elements: those who receive meals without charge as part of their benefits for being in the Navy; and those who must pay cash for the meals that they consume in the Enlisted Dining Facilities (EDFs). The first group is identified as "Rations In Kind" or RIK customers.

When RIK customers elect to eat in the dining hall, they are required to present their military ID card (green card) as well as a Class A meal pass (white card) to the Master At Arms (MAA). At this point, two forms of identification will verify that the RIK diner is, in fact, entitled to the meal for no charge. If the customer is not in the RIK category, that is a cash paying customer, then he/she is in the category called "Commuted Rations" or COMRATS.

When a COMRATS individual chooses to eat in the dining hall, he/she must present his/her military ID (green card) to the MAA who will then allow the individual entry to the serving line. The COMRATS diner must then pay for the individual food item that he/she selects.

The Naval Supply Systems Command established NAS Alameda as the Navy test site for the Cash/A La Carte or Item Pricing System. This concept differs from current operations mainly in that the diner will pay only for the food items selected. This Item Pricing concept is very similar to the method used in commercial cafeterias.

ASHORE TEST SITE

The Appropriated Fund Enlisted Dining Facility at NAS Alameda, CA is a very large facility which serves in excess of 25,000 meals per month. All food service personnel, including Mess Management Specialists (MS), Jack-of-the-Dusts (JOD), Records Keepers (RK), and the Food Service Officer (FSO), are located in this dining facility. This facility has two main lines serving cafeteria style with several food preparation areas designed for specific needs of select groups, such as flight galley and box lunches for remote personnel. In addition, there is a large dining area, the Ranger Wing, that can be used for an influx of scheduled groups of Navy personnel from afloat facilities.

From one central location all food service related functions, including the accounting, inventory, food preparation, and serving, take place. Overall administrative functions of reviewing and checking dining facility forms are also carried out in this location. These forms are completed by the Jack-of-the-Dusts, the Mess Management Specialists, and the Galley Captains and are reviewed by the Food Service Officer.

AFLOAT TEST SITE

The NAFSR test site for the afloat environment was conducted on the USS Constellation (CV-64). The enlisted dining facilities included two main galleys plus a short-order, fast food forward operation that is active 20 hours per day. With a crew of over 5,000 personnel, the enlisted dining facilities prepare approximately 20,000 meals per day. The food preparation and inventory requirements are enormous and thus tested the NAFSR systems ability to track food items in 11 different storage locations for inventory issuing and replenishments.

II. THE MANAGEMENT INFORMATION SYSTEM

In order to perform their functions of monitoring and controlling costs and operations, the managers in the Navy Enlisted Dining Facilities are, depending upon the viewpoint taken, either assisted or burdened by an information system that requires the preparation and review of more than 13 different documents. The completion cycles of the reports vary from meal-to-meal reports to monthly and quarterly reports. Many are prepared by office personnel or supervisors rather than by managers, but all must be reviewed carefully by the FSO.

The compilation, review, and analysis of these reports can consume a significant amount of the manager's time as well as the staff's time. Some of the reports are very long; some must be completed after each meal; and many require detailed calculations to be manually posted onto other forms, thereby causing simple clerical errors which can take considerable time to detect and correct.

All the time involved in reviewing, correcting, and/or validating these reports means less time spent in areas that are directly productive in an efficient food service operation. These tasks include food preparation, storeroom maintenance, and running the service lines. Other important activities, such as monitoring meal preparation, interacting with customers and hearing their suggestions, or formulating new ideas for effective food service operation, may not be given the attention that they need due to the time spent preparing forms. The Defense Audit Survey cited earlier has enumerated other problems with the current manual system including potential for fraud, waste, and abuse in the Navy food service arena.

THE MENU PRODUCTION MODULE

The Menu Production Module generates the quantities of all recipes and ingredients required in the preparation of meals to be served in the dining hall. This includes determining the number of specific ingredients required to be drawn from the storeroom as well as computing the amount of each ingredient needed for the preparation of each menu item. This module consists of a cyclic menu. Before using the module, each meal and the date it is to be served must be specified. After the cyclic menu is established the forecasting module is called to obtain the headcount and selection ratio projections for the specific menu item groupings. One output of this module is the cook's worksheet specifying the menu items and quantities of required ingredients. The ingredient quantities are expressed in values familiar to the cooks: pounds, ounces, tablespoons, teaspoons, cups, etc. All of the arithmetic extension of the Armed Forces Recipe Service recipes, from the 100 portions on the cards to the greater or lesser portions required to feed the projected customer load, are done by the computer. The problem that cooks have had in performing the calculations correctly is thus greatly reduced by this feature of the NAFSR system.

INVENTORY CONTROL MODULE

The Inventory Control Module (ICM) is designed to maintain current levels of all inventory items as well as produce all food orders required to replenish dining hall inventories. The ICM contains the following eight submodular functional levels:

1. Requisitioning
2. Receiving
3. Issues
4. Transfers
5. Surveys
6. Inventory
7. Billing
8. Reports

Requisitioning: This function documents the requisitioning of food items by Food Item Code (FIC). This software will check the outstanding requisition for a document number. If a document number is not found, a rough requisition is prepared. The system checks to see if each FIC is on the active order list. The amount to be ordered is determined from either manual input or from the high-limit for that FIC. After approval from the FSO the final requisition is printed. It is then put onto order cards and sent to the supplier.

Receiving: This function documents the food items that are received. The date of receipt and type of receir' for food items requisitioned, turned-in, and transferred-in are record(. as well as the document number. If a partial shipment is received, it is posted to the on-hand inventory and the balance due is entered in the outstanding requisition file. This file is not cleared until the order is completed.

Issues: This function documents the issue of food items, including those made to the Enlisted Dining Facility. The on-hand balance and total expenditures for the food item are updated to reflect these issues.

Transfers: This module documents the transfer of food items from one Navy activity to another. Transfer-outs are addressed together with the type of reimbursement that is encountered.

Surveys: This module documents the surveying of food items. If food items are lost as a result of physical deterioration, damage in handling, fire, water, or similar circumstances, and the value of the loss is $50 or greater per line item, a survey must be conducted by the FSO. If the loss is less than $50 a survey need not be done; the storeroom MS or the Inspector sends notification to the Records Keeper to post the loss in his records.

Inventory: This module documents inventory procedures including the type of inventory (i.e., rough, reinventory, or smooth). After the rough inventory has been performed, a smooth inventory document (Form 1059) is printed containing the current on-hand balance, unit price, and value of each food item.

Billing: This module documents the billing procedure. A statement showing the monthly cumulative value of issues made to private dining facilities is printed upon request.

Reports: This module documents the inventory report preparation procedures. The user has control over which report is to be prepared (i.e., NAVSUP 335 - "Subsistence Ledger", NAVSUP 367 - "Record of Receipts and Expenditures", or NAVSUP 1334 - "Expenditure Log") and the time period for which the reports are to be prepared.

ACCESS CONTROL/AUTOMATED HEADCOUNT MODULE

The Access Control Module is designed to provide real-time physical access control in all the regular appropriated fund dining halls which use electronic cash registers. The enlisted personnel who subsist on RIK currently show their meal card and are allowed to eat for no charge.

The Access Control Module provides a real-time physical access control system linking all the dining halls to the microprocessor. Personnel who subsist on RIK are required to carry a magnetic meal stripe meal card. The identification number on the magnetic stripe card is validated using a file in the central computer which contains each valid card number, including a starting and an expiration date, and historical data that indicate the meals and dollar value of food consumed using this meal card to date or within 24 hours.

The validation of the meal card includes several checks. The first check determines whether the meal card number is valid. If the number is valid, the meal is allowed to be rung up as a credit sale. If the meal card number is invalid, the register becomes locked so as not to permit the sale to be run up for credit (i.e., at the Government's expense). In this instance, the register has a guaranteed lockout which requires that the meal be rung up for cash. All valid card numbers are stored in the Meal Card File and, therefore, if the meal card number is not resident in the Meal Card File, it is assumed to be invalid. Further, the starting and expiration dates of each meal card number are maintained in the file. Therefore, a meal card number is considered invalid if the date when the card is being used does not fall between starting and expiration dates for that meal card.

The second check is a repeated meal card usage check. The Meal Card File maintains historical data on meal consumption which indicates the number of each meal (i.e.,1 breakfast, 2 lunch, 3 dinner, etc.) consumed and in which facility the meal was consumed during the previous 24-hour period. In this instance, an invalid meal card message is sent to the register which then requires the sale to be rung up for cash, If the repeated usage check analysis reveals that the meal card has been used once during the same meal period at the same dining hall, a message indicating that the meal is a second is sent to the register. This message does not automatically lock out the register, and it also does not count the meal as an additional meal served for headcount purposes. The Meal Card File maintains the amount of seconds used by each meal card to permit analysis after the meal.

The Meal Card File is resident on the microprocessor. All Meal Card File updating and access are restricted to personnel authorized by the Food Service Officer. The meal card control activity is centralized to the microprocessor with possible access via terminals for updating by the personnel office.

The Access Control Module requires physical equipment, including magnetic stripe card readers to read encoded identification information on the meal cards in the dining halls, and all necessary interfaces including communications (cabling etc.) to communicate this information to the Durango microprocessor and to transmit authorization back to the dining hall register. The software necessary to support the communications hardware has been provided by NRDEC as part of the NAFSR system.

The Access Control/Automated Headcount Module also contains the software necessary to transfer data from the ECRs to the microcomputer after each meal. The data to be transferred includes accounting summaries for each type of personnel served and additional summaries detailing item sales and meal card summaries if physical access control is not feasible. The data transfer is accomplished using a communication interface to link the ECRs and microcomputer.

ACCOUNTING MODULE

The Accounting Module generates the information necessary for the computer creation of the dining hall and base accounting forms that must currently be prepared by the food service office.

The initial input of the Accounting Module is the dining hall cash and attendance summary data for the earned credits file. The data required for this file are input either manually or via Point of Sale (POS) Electronic Cash Registers (ECRs) in the dining halls. Dining halls operating under Item Pricing will use ECRs to generate menu item sales and cash and attendance summaries for each meal. The hard copy output, currently used by the Navy as an audit trail, is transferred directly to the microcomputer system using a communications link between the dining hall cash registers and the microprocessor. This data is then stored in the "earned credits" file.

The Accounting Module will produce the following standard forms:

(1) NAVSUP 333, EDF Control Record
(2) NAVSUP 1292, Recapitulation of Meal Record
(3) NAVSUP 1336, Requisition Log
(4) NAVSUP 1340, Special Meals Report
(5) NAVSUP 1357, Ration and Sales Report
(6) NAVSUP 1358, EDF Operating Statement

It should be noted that all of the food service forms will be computer generated.

REPORT PREPARATION/ARCHIVING MODULE

The Report Preparation Module produces printed reports from report data stored on floppy disks in print image format. This module dumps down data spooled on disk in report format. By saving all data on disk rather than

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printing the data as it is generated, the food service personnel can schedule report printing at nonpeak periods and better utilize the microcomputer during peak periods.

The Navy Automated Food Service Records (NAFSR) System reports are stored as a sequential file in record order. Data is stored as a 217 character image. The first character is a carriage control character; the other 216 characters are the report data generated in the various system modules.

Reports are stacked in sequence in module order on individual mini-floppy (5 1/4 inch) disks. For example, all file maintenance reports would be stored in run sequence on a mini-floppy designated for use in the File Maintenance Module.

The Report Generator Module is designed to minimize the wait-time created when terminals or the main computer are attempting to access the printer. A special printout partition and program is used to allow system modules and terminals to spool print files. The printout program then accesses this spooled file for rapid, uninterrupted printing.

The printer program accesses a printer control file using the printer partition and spool files generated by each user partition or module. All print partition or module processing may be printed in a batch mode print operation during slack periods.

HARDWARE

Ashore Environment: The hardware used in the test phase of NAFSR must be described in two environments. The Technology Demonstrator used in the NAFSR ashore test is quite different from the hardware utilized in the NAFSR afloat test environment. The NAFSR ashore equipment was configured as in Figure 1 and was comprised of the following items:

*1 Durango Microcomputer System model #850 that had the following components:

    1 Video Display Unit (VDU)
    1 Printer
    1 Keyboard
    2 Floppy diskette drives (5 1/4") 1 megabyte, 2 Fixed disk drives (14") 48 megabyte

*2 Electronic Data Terminals, Decwriter model III.

*2 Electronic Cash Registers, Point-of-Sale (ECR/POS) DTS model 521 with the following features:

    Magnetic Stripe Card Readers
    Poll Displays
    Expanded Keyboards
    Integrated Modems
    Expanded Memory
    Telecommunications Board

*1 Electronic Card Embosser, Pitney Bowes model 7700.

*1 Magnetic Stripe Card Issuing Station, Photo ID Systems model four with the following features:

1 Polaroid split lense camera system
1 Magnetic Stripe Card Encoder
1 Magnetic Stripe Card Laminator
1 Photo Die
6,000 ID Data Cards
6,000 Magnetic Stripe Plastic Jackets

*2 Uninterruptable Power Supplies (UPS) Topaz (800VA).

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                        ┌──────────────────┐
                        │ FOOD SERVICE     │      ┌──────────────────┐
                        │ OFFICE           │ RS232│ DTS              │
                        ├──────────────────┤◄────►│ ANSWER-TRAN      │
                        │ DURANGO F-85     │      │ CREDIT-TRAN      │
  ┌──────────────┐      │ MICROCOMPUTER    │      │ PCB's            │
  │ RANGER WING  │      └──────────────────┘      └──────────────────┘
  ├──────────────┤                                        │ IRC
  │ CARD ISSUING │      RS232          RS232      ┌──────────────────┐
  │ AREA         │                                │ DINING HALL      │
  ├──────────────┤                                │ A-RATION-LINE    │
  │ PITNEY-      │                                ├──────────────────┤
  │ BOWES        │                                │ DTS 521          │
  │ 7700         │                                │ ECR/POS # 1      │
  └──────────────┘                                └──────────────────┘
                                                          │ IRC
   ┌──────────────┐   ┌──────────────┐          ┌──────────────────┐
   │ GALLEY (RK)  │   │ LEADING      │          │ DINING HALL      │
   │ OFFICE       │   │ MMS          │          │ S.O.-LINE        │
   ├──────────────┤   │ OFFICE       │          ├──────────────────┤
   │ DAS-DEC III  │   ├──────────────┤          │ DTS 521          │
   │ LA-120       │   │ DAS-DEC III  │          │ ECR/POS # 2      │
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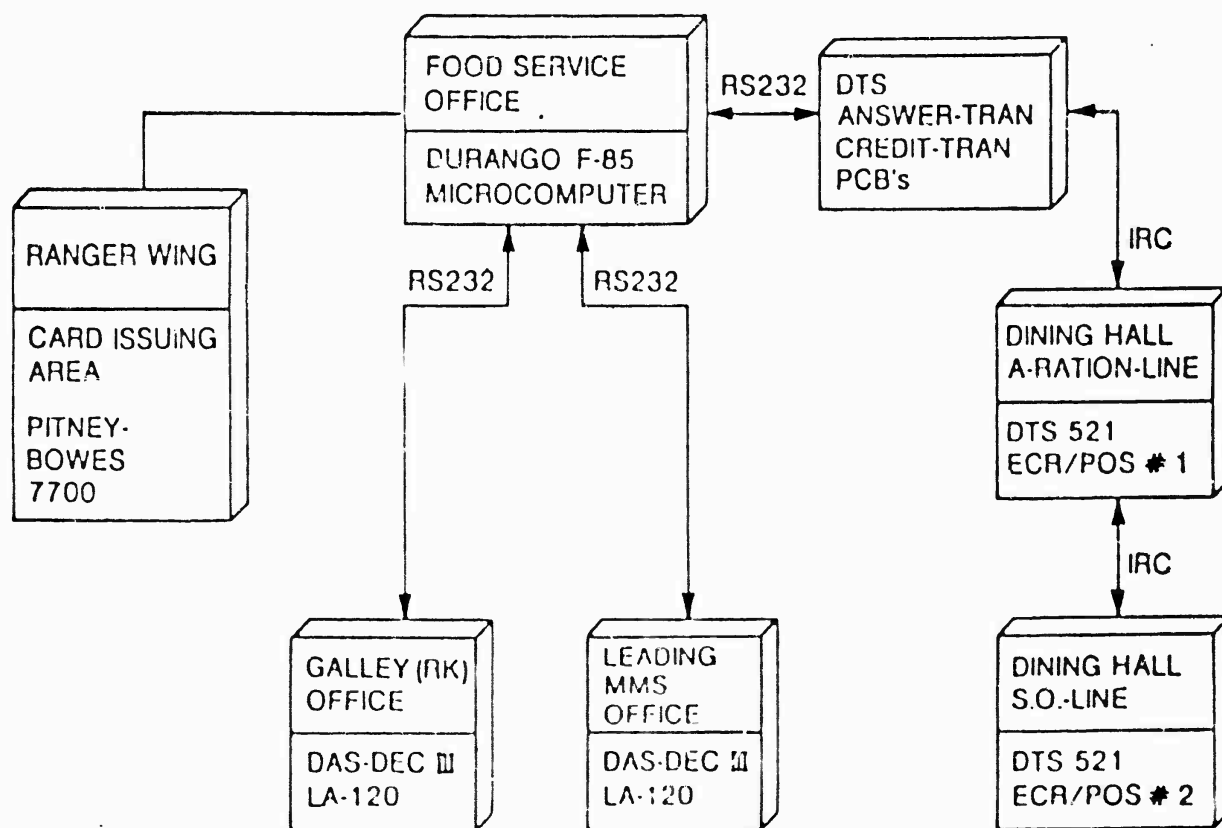
Figure 1. Schematic of Navy automated food service records (NAFSR) system.

Afloat Environment: The NAFSR Afloat equipment was installed on the USS Constellation, CV-64, in January 1984 as a Technology Demonstrator unit. The configuration is shown in Figure 2. The following components were utilized:

*1 Durango Microcomputer System model #911 that had the following components:

    1 Video Display Unit (VDU)
    1 Printer
    1 Keyboard
    1 Floppy diskette drive (5 1/4") 1 megabyte
    2 Fixed disk drives (5 1/4") 40 megabyte

    *4 Remote Terminal Areas:

    4 Video Display Units (VDU) Poppy Stations
    4 Printers OKIDATA model 83A

    *1 Uninterruptable Power Supply (UPS) Topaz (800VA).

FAILURE PROTECTION

One of the more frequent questions asked by potential users of automated systems is, "What happens if we lose power or the system goes down - will I lose my data?" There are several contingency plans that have been incorporated into the NAFSR system design to minimize problems associated with computer system failure. For example, loss of electrical power is compensated for by battery packs on the cash registers and the use of the UPS on the main computer. This will permit the collection of meal headcounts and item selections even if a power failure occurs in the dining facility. Electrical fluctuations are smoothed by voltage regulators in order to provide continuous computer operations at remote terminal areas.

For the more serious problem of computer system failure, a manual backup procedure was developed. While the system is inoperable, the data will be retained on their original data forms until the system is brought up again. The software is designed to then accept the accumulated data when entered manually. The operator merely keys in the dates and meals for the data he or she is entering. This feature may also be used to input data after periods when the computer normally might not be operating, such as during a "midnight" meal.

A provision is also made so that the data may be corrected if it is determined that some information currently residing in the system data base is faulty. Of course, there is an element of security required due to the need to maintain a verifiable audit trail. The computer systems operator or staff accountant must retain relevant information to show an auditor that the corrections were necessary and were made. Automatic exception reports are generated when such corrections are made.

Another safeguard is that a copy of the data base is stored in a secured location such as a safe. The data files maintained in the automated system or copied on a regular basis and stored in the secured area. These files are retained until it is determined they are no longer necessary.

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                              ┌─────────────────┐              ┌──────────────┐
                              │ NAFSR           │              │ WARD ROOM    │
                              │ DURANGO 911     │              │ OFFICE       │
                              │ FSO             │              │ POPPY STATION│
                              │ 2-217-2Q        │              │ 2-44-1Q      │
                              │ X7530           │              │ T 4          │
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      │ TOPAZ            │
      │ UNINTERRUPTABLE  │
      │ POWER SUPPLY     │
      │ UPS              │                                     ┌──────────────┐
      └──────────────────┘                                    │ FOOD SERVICE │
                                                              │ OFFICE       │
                                                              │ POPPY STATION│
                                                              │ 2-217-2Q     │
      ┌──────────────────┐                                    │ X7530        │
      │ ISO-3            │                                     │ T 3          │
      │ LINE            │                                     └──────────────┘
      │ CONDITIONER      │
      │ AND FILTER       │
      └──────────────────┘
                                                              ┌──────────────┐
                                                              │ CPO MESS     │
                                                              │ OFFICE       │
      ┌──────────────────┐                                    │ POPPY STATION│
      │ SHIPS           │                                     │ 3-185-2A     │
      │ POWER            │                                     │ X7609        │
      │ 110 VOLTS        │                                     │ T 7          │
      └──────────────────┘                                    └──────────────┘

                                                              ┌──────────────┐
                                                              │ WARD ROOM    │
                                                              │ MESS OFFICE  │
                                                              │ POPPY STATION│
                                                              │ 2-154-1Q     │
                                                              │ X7419        │
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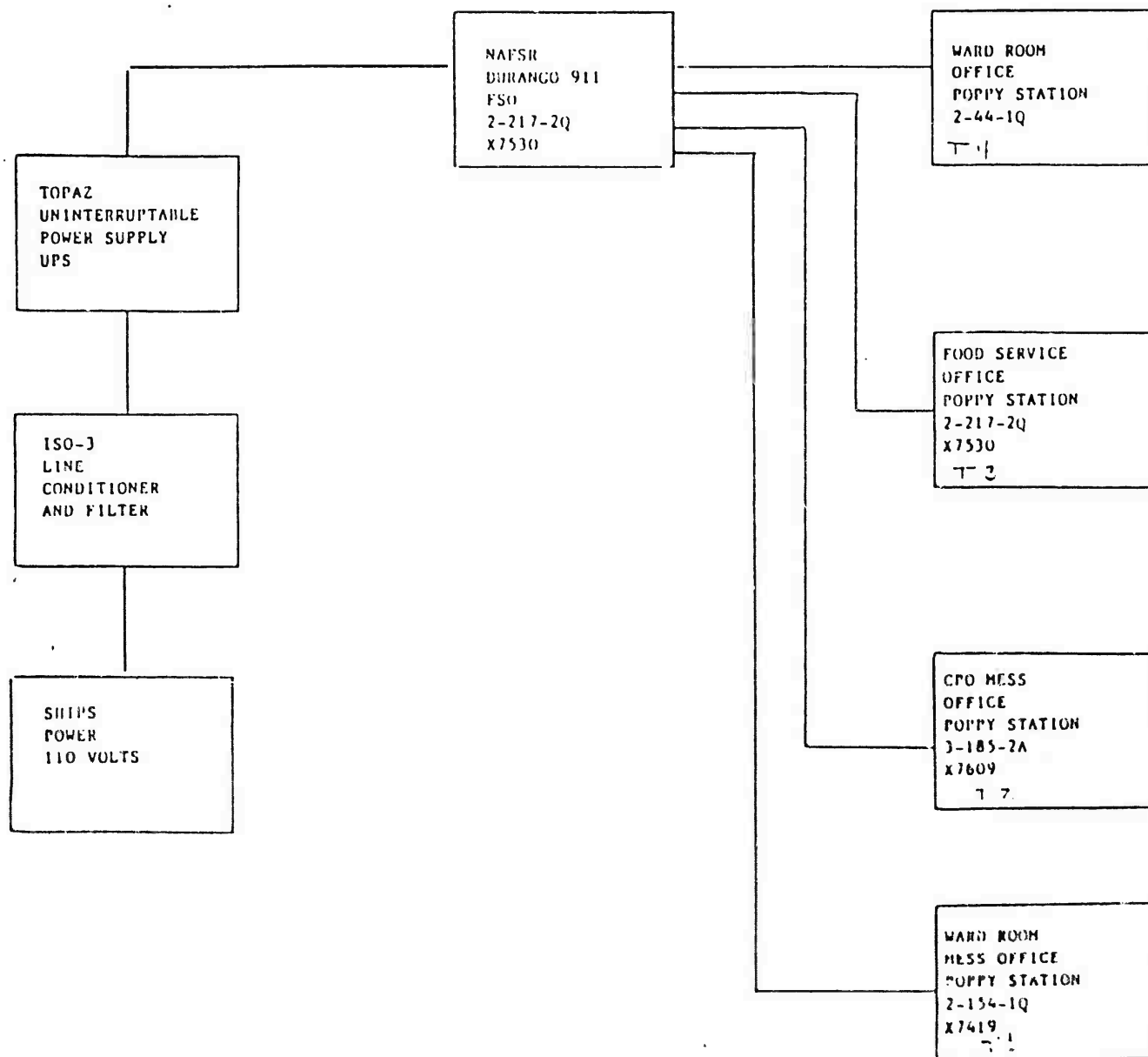
Figure 2. USS Constellation NAFSR overview.

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III. TEST RESULTS

BACKGROUND

The current manual system was operated by the Food Service Office Records Keeper concurrently with the operation of the automated system for the first 3 months of the test effort in order to verify the results of the automated system. However, it should be noted that the automated system was designed to work with the existing forms so there would not be a difficult transition from the manual to the automated system. In fact, the transition was easily accomplished and the manual system was phased out on schedule.

Prior to shipping the NAFSR Technology Demonstrator to NAS Alameda for a 6-month evaluation period, the prototype system software and data base development was completed at Natick. Since it was designed as an independent stand-alone system, NAFSR was ready for implementation upon arrival at the test site.

There were two major data collection periods. The first occurred before NAFSR was installed and constituted an evaluation of the current manual system. The second data collection effort was undertaken during the last month of the test period. Thus, this information provided a basis for an evaluation of the impact of the Ashore automated system. There was no data collection phase for the afloat environment.

The data collection focused on three major areas: access control, food service personnel workload, and operational impacts. Methods used to collect this information included detailed work sampling, questionnaires, interviews, and cost data.

ACCESS CONTROL

Meal Card Issuing: A new procedure was established for issuing meal cards to military personnel. Previously, personnel who were on RIK were issued a paper meal card by their respective units. The NAFSR system required these people to acquire documentation from their units indicating their right to RIK status and to then travel to the card issuing area located in the EDF on the base to acquire a new embossed plastic stripe meal card with attached picture as shown in Figure 3.

A total of 963 cards were issued during the test effort. There were 79 (8%) cards that were voided as personnel had either transferred to COMRATS, were separated from the service, or transferred to another base. The total number of personnel issued meal cards in a given month is shown in Table 1.

TABLE 1. NAFSR Test Meal Cards Issued.

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Total
Cards Issued	180	205	157	174	168	57	22	963
Voided Cards	10	16	11	18	11	9	4	79
Training Samples	34	7	5	8	0	1	5	60

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Figure 3. NAFSR magnetic stripe meal card.

All Measurements In Inches

Existing Signature System: The Defense Audit Service (DAS) review of military headcount procedures indicated that 23 percent of the signature sheet entries were questionable. This report cited a sample of 1,448 from a total of 40,348 signature sheet entries at 7 dining facilities which disclosed that 23 percent were questionable. The report cited that 7 percent of this 23 percent were for entries with illegal signatures or numbers which could not be verified, and the remaining 16 percent were cards recorded as issued to different individuals, not assigned for use, for individuals not on unit rosters, for personnel drawing monetary allowances, etc.

Real-Time Access Control: In order to implement the real-time access control feature of the NAFSR system, it was necessary to more precisely and comprehensively define the types of meal card exceptions and infractions than is necessary with the current manual signature headcount system. Twelve types of exceptions and infractions were defined and used to determine the conditions under which the system would lock out the cash register from a credit sale and to develop messages allowing the cashier to understand the basis for rejecting the card. Table 2 summarizes these exceptions and infractions, some of which the cashier may override (i.e., MOA - Manual Override Available) if the person presents a valid reason, while others may not be overridden (i.e., NMO - No Manual Override) under any circumstances. The exceptions that are manually overrideable represent the necessary "reason" input by the cashier when manually overriding the computer-generated credit sale lockout.

TABLE 2.   Exception and Infraction Messages for the NAFSR
Access Control Module.

	MESSAGE	MOA/NMO	OCCURRENCE
1)	TDY	MOA	When user does not have a card and gives TDY as a reason.
2)	NEW ON BASE	MOA	When user does not have a card and gives New on Base as a reason.
3)	SSN NOT ON FILE	MOA	When user's SSN is not on file and he/she has had his/her card read.
4)	MAJOR MEALS INF	MOA	When user has received a meal under RIK at more meal periods than authorized.
5)	STOLEN CARD	MOA	When user does have a card read but it was reported stolen. User must show other identification.

NOTE: MOA = Manual Override Available
         NMO = No Manual Override

TABLE 2. Exception and Infraction Messages for the NAFSR
Access Control Module (cont'd).

MESSAGE	MOA/NMO	OCCURRENCE
6) LOST CARD	MOA	When user does have a card read but it was reported lost. User must show other identification.
7) SECOND HELPING	MOA	When user has already been recorded in the Daily RIK file as having had a meal during this meal period.
8) DAY LMT. EXC	NMO	When user is TDY or New on Base and has not gotten an ID card in the time allowed.
9) WRONG CARD IS #	NMO	When user has had a card read and card issue number is less than the one that corresponds to the card issue number in the Daily Valid RIK File.
10) DINING HALL INF	NMO	When user has had a meal in one dining hall and tries to buy another during the same meal period in another dining hall.
11) TOO MANY SECONDS	NMO	When user has had more than the maximum allowable number of seconds during the meal period.
12) INVALID REASON	NMO	When user has given an unauthorized reason for not having an ID card, or reason for not having a card differs from the one already in the Daily RIK File.

NOTE: MOA = Manual Override Available
      NMO = No Manual Override

Data Collection: Two sets of data were collected for each of the three areas of investigation: work sampling, headcount forecasts, and arrival/ service times at the cashier station. Of the two sets of data, the first was taken prior to the installation of the NAFSR and the follow-up was collected near the end of the 6-month test phase. The associated forms used in the data collection can be found in Appendix A.

The exceptions that can be manually overridden are not infractions to the extent that these individuals should not be allowed to consume food at the Government's expense. However, they do represent a situation whereby for various circumstances (described in Table 2) an individual does not have a valid Social Security Number (SSN) resident in the computer. For example, the invalid SSN exception message does not really indicate that the individual has an invalid SSN and should not be allowed to eat. This exception results when the individual acquires a valid meal card (from the central issuing point), but the issuer was not able to input the SSN of the new meal card holder into the computer. This computer updating procedure requires the issuer to update the RIK master file on a routine basis (typically three times per week) and input all the SSNs of new meal card holders into the computer. If a person acquires a meal card and uses the meal card prior to the issuer inputing the SSN into the computer, then the ECR would display an overrideable infraction entitled "INVALID SSN" which merely signifies that this SSN is not in the SSN validation file in the computer. However, since the individual has a new automated system plastic meal card the exception is overridden, and most importantly, a verifiable audit trail is maintained for all these occurrences.

A verifiable audit trail is maintained for all the manually overridden exceptions including new on base, unreadable card, individual on TDY, and card claimed as lost or stolen. The verifiable audit trail consists of the individual's SSN, date, time, meal number, and reason for the exception. Therefore, the NAFSR access control/automated headcount module virtually eliminates all of the questionable signature sheet entries as cited by Defense Audit Survey (DAS) review.

A summary of the exceptions occurring due to a manual override at the cash register is presented in Table 3. As previously described, personnel who register as "INVALID SSN" actually have a meal card, but the file in the computer has not been updated to reflect that fact. The other exceptions (unreadable card, forgotten card, and lost card) all indicate that the

TABLE 3. Summary of Access Control Exceptions.

	B	L	D	OVERALL
Invalid SSN	6.1	6.2	6.9	6.4%
New on Base (people have not acquired a meal card)	2.2	1.4	1.8	1.8%
Unreadable Card (card was x-rayed)	1.2	1.3	1.5	1.3%
TDY	0.4	1.4	1.5	1.1%
Lost Card (or forgotten card)	2.6	2.3	2.3	2.4%
			TOTAL:	13.0%

Note: B = Breakfast, L = Lunch, D = Dinner

individual has a valid SSN in the file which was verified as the person was waiting at the cash register. The verification process requires the cashier to input the persons SSN with the appropriate reason code and the computer checks to make certain the SSN is valid. Another exception is for personnel on TDY. In this case, these people must possess a valid copy of their TDY orders which clearly states that they are entitled to Rations in Kind (i.e., at the Government's expense). Therefore, these exceptions all require the individual claiming authorization to obtain Rations in Kind to have some sort of valid proof, whether it be a plastic meal card, orders, or valid SSN in the computer file.

There is also an exception for personnel new on the base who have not had an opportunity to acquire a meal card. These people are informed that they must acquire a meal card within a specified period of time (for example, 5 days) or they will have to pay for meals consumed in the dining facility. An analysis of these exceptions was made by reviewing the reports of personnel who claimed to be new on base and checking to determine if, in fact, they acquired a meal.

The analysis revealed that 40 percent of these people never acquired a meal card. Therefore, since 1.8 percent of the meals were served to personnel claiming status as new on base and entitled to Rations-in-Kind, then less than 1 percent (or 40% of 1.8% = .72%) of meals served are questionable as the authorization of the diner to consume meals at Government expense.

All other true infractions, identified in Table 2 as NMO (No Manual Override), were eliminated by the system. Therefore, one may draw the conclusion that questionable headcounts were reduced from a DAS determined pre-NAFSR level of 23 percent to less than 1.0 percent identified in the previous paragraph. One analysis of the signature records (NAVSUP 1291) done by the Leading Chief Mess Management Specialist indicated that invalid names, SSNs, or unit identification codes that were nonreadable were in excess of 80 percent, which is higher than the estimate from the DAS report and indicates Alameda has a more significant problem. Hence our cost estimates are understated.

Work Sampling: Work sampling was used to measure the percentage of time that dining hall personnel spend on various tasks throughout the day. The work sampling data revealed that after the NAFSR was installed administrative personnel, such as the Galley Captain and Leading Mess Management Specialist were able to spend more time on administrative and supervisory duties and less time on food preparation. The cooks spend more of their time actually preparing the food. In some instances, workers increased their productive use of time up to 85 percent of what it had been before the test. In general, dining hall personnel used their time more effectively after the installation of the NAFSR.

Headcount Forecasting: The headcount forecasting analysis measures the accuracy of the computer-generated headcount and the manually adjusted headcount compared to the actual headcount (see Table 4). The headcount forecasting equations used by NAFSR are based on variables such as the day of the week, the number of days from payday, whether the day is a holiday, and present for duty strength. These headcount equations are fairly accurate if the present for duty strength does not vary to a great degree. However, when

TABLE 4. Headcount Forecasts.

	% Error for Computer-Generated Forecast	% Error for Forecast After Manual Adjustment
Breakfast	42	13
Lunch	45	15
Dinner	37	22
	124	50

Percentage of computer-generated forecasts closer to actual headcount = 16%
Percentage of forecasts after manual adjustment closer to actual headcount = 78%
Percentage of computer-generated forecasts and forecast after manual adjustment = 6%

there are many fluctuations in the present for duty strength due to transients, as is the case in Alameda, it is difficult to predict the headcount. NAS Alameda has a high number of transients; therefore, the headcounts manually adjusted by dining hall personnel were much more accurate than the computer-generated forecasts.

Arrival and Service Rates: As shown in Table 5, the data collected before and after the installation of the NAFSR indicated that the arrival rate was faster after the installation of NAFSR (i.e., more people arrived in a shorter time span). In spite of this, the service rate was 14 percent faster (this 14 percent was determined as follows for Table 5: Average service rate = RIK customer, [(pre-test time) - (in-test time)]/pre-test time) = (17.8 - 15.3)/17.8 = 14%). The test clearly shows an increase in the speed of service after the installation of the NAFSR.

SIMULATION OF ECR QUEUES

A simulation of the electronic cash register (ECR) operations was prepared in order to determine the effect of using the magnetic stripe card reader on service line rates as well as on the length of the queue at the ECR station. In order to conduct this simulation, arrival and service rate data were collected during each meal period at the main dining facility prior to and during the test effort. The arrival rate data collected was the mean time between arrivals to the queue, if one existed, at the ECR. The service rate data collected was the total processing time of the ECR per person, not including the time spent waiting in line. This time was defined as the time spent from initial arrival at the ECR, when the cashier begins to ring up the sale, until the sale is complete and the customer may walk away from the ECR. The service rate data was further segregated into two categories: customers with meal cards (RIK) and customers paying cash (COMRATS).

TABLE 5. Average Arrival and Service Times (in seconds) at the Cash Register Stations.

	Pretest		In-Test	
	Mean	Std Dev	Mean	Std Dev
Arrival Rate				
Bkfst	40.1	38.7	29.3	28.6
Lun-Main	29.0	30.0	25.6	23.7
Lun-Short	25.8	31.3	26.6	25.4
Din-Main	34.4	31.7	29.3	26.7
Din-Short	30.9	29.6	33.0	31.7
Average Service Rate				
RIK customers	17.8	9.1	15.3	6.8
COMRATS customers	23.4	10.6	22.9	9.5
Average Service Rate by Meal (RIK)				
Bkfst	15.3	9.8	15.5	7.0
Lun-Main	18.2	9.2	13.4	5.7
Lun-Short	17.4	7.3	15.5	6.6
Din-Main	17.7	8.9	15.7	6.7
Din-Short	23.1	11.5	16.7	7.6
Average Service Rate by Meal (COMRATS)				
Bkfst	22.2	10.8	21.2	9.7
Lun-Main	23.6	10.7	23.2	9.5
Lun-Short	21.5	9.5	23.0	8.0
Din-Main	23.5	9.7	25.4	9.9
Din-Short	29.3	11.4	24.1	9.1

It should be pointed out that higher service rates for COMRATS is due to making change.

AUTOMATED FORECASTING

The history of customers served forms the basis for forecasting customer loads and thereby planning how much food to order, store, or prepare. Before focusing more explicitly on the test results in these areas, the accuracy of forecasts made under the manual and the automated systems is both an interesting and important comparison. The more accurate forecasting results, of course, should be used for decisions regarding inventory control and food preparation.

It should be noted that NAS Alameda represented a very atypical case for the Navy. There was a highly variable turnout for headcounts on Friday, Saturday, and Sunday meals with literally no advance warning prior to a weekend as to how many reservists would be attending meals. There were Air Wings, National Guard units, and reserve components that would influx over weekend periods. This created quite a problem for both the automated forecasting system as well as for the manual system.

A review of the manual operation indicates that the attendance forecasts were estimated to be quite accurate in the case of NAS Alameda. Whether this was the result of careful calculations or a simple insight gained from years of experience is not known. However, food service managers did exercise their prerogative to override the computer-generated predictions during the NAFSR test as the results show (see Table 4).

INVENTORY CONTROL

Another of the DAS and the GAO reports' findings highlighted the problem of inventory control in military dining facilities. Management controls in this area were weak and resulted in substantial losses. Automation was thought, by DAS and GAO, to be one answer to the need for tighter control of inventories and results from the NAFSR test indicate that automation may indeed provide a powerful management tool.

The NAFSR system requires food service personnel to monitor food waste resulting from inventory losses very closely. The ingredients received from the commissary are all input using the inventory module and an up-to-date book inventory is maintained in the computer files. An ingredient can only be removed from the book inventory if it is issued to the galley. Otherwise, the file maintenance module must be used to monitor and update the book inventory. In doing so, an audit trail is generated automatically. Each time an inventory reconciliation is performed, the computer maintains a historical record of all differences between the physical and the book inventories. This control encourages store-keeper personnel to monitor very closely ingredient inventory Food Item Code (FIC) levels. This important management objective is facilitated by automation.

FOOD SERVICE LABOR IMPACT

Although the NAFSR concept was not designed or intended to reduce labor requirements in Navy dining facilities, the automated system should have a significant impact upon the distribution of activities performed by both managers and workers. The results described in this section document the difference in the distribution of times associated with activities performed under the manual and the automated food service information systems.

Food Service Officer: The Food Service Officer (FSO) is the person who is responsible for the food expenditures, monies collected, and rations provided. These accounting and finance reports are forwarded for review and compilation at the Navy Food Service System Office (NAVFSSO) located in the Washington Navy Yard, Washington, DC. The duties as a function of time for pre-test verses in-test data, Table 6, show that the FSO spent 24% more time in reviewing and authorizing reports. The galley operation benefited from the FSO's time redistribution by all owing him/her to quadruple time spent on supervision.

Food Service Records Keeper: The individual(s) most directly affected by the NAFSR requirements is the food service accountant whose duty is to input, review, and correct the wealth of accounting data which in turn comprise the management reports. The Food Service Officer at NAS Alameda delegated much of the responsibility for computer system operation, security file updating, and audit trail printout generation to the Food Service Records Keeper.

In order to quantify the time taken to complete his tasks, the Records Keeper at NAS Alameda was asked to maintain a time log for a 1-week period in both the pretest and in-test data collection periods. The log required the Records Keeper to write a three digit code every 15 minutes. The first digit noted the location where he was working and the second two digits noted the activity being performed. In both data collection periods a list of categorized activities was provided on the time log. Examples of the time logs are provided in Appendix A.

It should be noted that there was only one individual performing the Food Service Record Keeper's function at NAS Alameda, and this individual worked approximately the same number of hours prior to, as well as during, the test effort. The Records Keeper was a civilian employee and therefore had pre-scheduled, regular working hours.

Although the Records Keeper's distribution of time allocation does not reflect a great shift in time spent on various tasks, it should be emphasized that the Records Keeper's duties are in fact to control the forms for all the EDF's activities. NAFSR reduces the number of simple arithmetic errors. One must be cautious in attributing too much significance to these figures in Table 6, however, as the standard error of measurement for these values is quite large. One conclusion that can be drawn from the results in Table 6 is simply that more time was spent on accounting-related productive tasks under NAFSR than was spent on similar type activities under the manual system.

Jack-of-the-Dust: NAFSR had a major impact on the job functions of Jack-of-the-Dust (JOD) personnel. The percentages of time spent on these functions are presented in Table 6 for the pretest and in-test data collection periods. For example, during the test, these individuals spent 20% [(Pretest data) -(In-test data))/(Pretest data)] less time preparing food service forms than they did before the test. Some reduction in this activity was anticipated since NAFSR generates food service forms automatically.

The time spent on administrative and supply activities was 90% under the the manual system and 95% under the NAFSR operations--indicating that the level of effort required is comparable under either the manual or the automated operations. It can be argued, however, that efficiency under the automated system is higher than under the manual operations. With the NAFSR technology, more time is spent on checking and maintaining accurate inventory levels and less time adding and subtracting numbers required in maintaining a manual card inventory. In fact, the 24% reduction in the amount of number crunching paperwork was affected by NAFSR even though a considerable amount of time is required and actually used for each meal.

Leading Mess Management Specialist: Prior to the implementation of the NAFSR, the Leading Mess Management Specialist (LMS) spent half (50%) of his/her time on food preparation. This was reduced by 70% to 15% in the automated

TABLE 6. Duties as a Function of Time Spent by Classification (% of time)
(working sampling data).

Classification	Activity*	Pretest Data	In-Test Data
Food Service Officer	Supervising	3.3%	13.6%
	Administrative	35.5	17.4
	Reports Preparation	40.1	64.4
	Miscellaneous	20.6	5.6
Records Keeper	Forms Preparation	61.6	61.8
	Cannot be found	3.3	0.9
	Miscellaneous	35.6	37.3
Leading Mess Management Specialist	Food Preparation	50.0	12.3
	Supervising	16.7	66.1
	Miscellaneous	33.3	21.5
Galley Captain	Food Preparation	11.3	1.1
	Cooking	0.5	1.7
	Serving	3.7	2.8
	Supply	1.8	2.8
	Administration	33.0	29.8
	Supervising	26.4	15.1
	Other Productive (out of galley) Duties	14.7	49.4
Jack-of-the-Dust	Supply	44.2	50.2
	Administrative	29.8	24.0
	Picking up supplies	15.4	20.7
	Miscellaneous	10.6	5.1
Master-at-Arms	Administrative	59.2	78.5
	Reports	5.8	3.9
	Miscellaneous	35.0	17.6

*All activities are defined in "Job Activity" in Appendix A.

operation. In addition, after the implementation of the NAFSR he/she spent four times as much time supervising Mess Management Specialists in food preparation.

Galley Captain: This shift supervisor's role in food preparation was reduced by 90% (i.e., 11.3% down to 1.1%). This is a very significant reduction which will contribute to the overall improvement in freeing-up the supervisors to supervise the galley personnel and devote time toward out-of-the-galley duties.

The NAFSR has a Projected Ingredient Requirements Program to automatically generate long-range raw food requirements. Therefore, the 36 hours typically spent doing this are virtually eliminated. Further, the 12 hours typically spent by an MS in a detailed review and modification of the raw food requirements are reduced considerably since the MS would in all likelihood only have to make some minor ingredient changes if, in fact, any modification was required at all.

ELECTRONIC CASH REGISTER OPERATIONS

While it is clear from the customer comments that NAFSR system was accepted, there is still the question as to whether the real-time access control procedures impose an additional delay at the cash registers. Results pertinent to this question are presented below.

As shown by the data summarized in Table 5, the ECRs were as fast or faster during the test using the magnetic strip card readers when compared to the pretest situation where a paper meal card was carried and the cashier merely input the six digit meal card number and performed no real validation checks on the RIK status of each card holder. The average service rate for the ECRs is defined as the time from when a person actually arrives at the ECR to be processed (but does not include the time waiting in line) to the time when the individual leaves the ECR. When the customer was using the magnetic stripe meal card, the average service time actually dropped from 17.8 to 15.3 seconds, which is a 14 precent reduction. In addition, the average service rate when the customer was paying cash was virtually unchanged. As stated previously, there was a higher number of patrons for the in-test conditions and still the service rates were equal to or lower than those observed under manual operations.

TABLE 7. Electronic Cash Register Simulation Results.

	Mean Length of Queue (Average Number of People in Line)
Pretest Arrival, Pretest Service Rates Lunch-Main Line	1.81
In-Test Arrival, In-Test Service Rates Lunch-Main Line	1.26

A simulation of the electronic cash register operations was prepared to determine the effect of using the magnetic stripe card reader on service line rates as well as on the length of the queue at the ECR station. The results of the ECR simulation are displayed above. As the summarized results in Table 7 show, there was a significant decrease in the average number of people in line (pretest compared to in-test).

IV. CUSTOMER SATISFACTION AT NAS ALAMEDA PRIOR TO AND AFTER INTRODUCTION OF NAVY AUTOMATED FOOD SERVICE RECORDS (NAFSR)

Data were collected in May 1983 from Navy and Marine servicemembers at Naval Air Station, Alameda to record satisfaction with the food service system prior to the introduction of the Navy Automated Food Service Records system. Similar data were again collected in January of 1984, 6 months after the system had been in operation. It was considered possible that components of the system (e.g., headcount prediction, order generation, determination of ingredient amount, new cashier checkout) could affect the performance of the dining facility, and as a consequence, the satisfaction of the customers, either positively or negatively. After all, incorrect prediction of headcount, or failure to use a module correctly could result in planning or food preparation errors that would adversely affect service to the customer.

ACCEPTANCE OF MEALS

Customers were asked to indicate, using a 9-point scale ranging from "dislike extremely" to "like extremely", how much they liked their breakfast, lunch, or dinner meal. Data were collected from two breakfasts, three lunches, and three dinners at each time of rating.

TABLE 8. Customer Satisfaction With Meals.

Meal	1983		1984		
	$\underline{X}$	$\underline{N}$	$\underline{X}$	$\underline{N}$	$\underline{t}$
Breakfast	6.52	104	7.06	79	2.34*
Lunch	6.12	107	6.23	71	< 1
Dinner	6.74	109	5.73	89	3.75*

*Significant based on a 95 percent confidence level.

Table 8 reveals no clear pattern that can be related to automation. Breakfast is rated higher, whereas dinner is rated lower. No significant change occurred for lunch. With the limited number of meals sampled, changes in customer satisfaction may be attributed to changes in menu as well as automation.

FOOD SERVICE SURVEY

In addition to ratings of particular meals, customers were asked to evaluate a number of characteristics of the dining facility (see Table 9). Again, measures were taken prior to and after the introduction of the automated system. The ratings were given on a 7-point scale, ranging from very bad (1) to very good (7), with 4 being the neutral point.

Generally, the perception of service at the dining facility did not change between the two test periods.

TABLE 9. Evaluations of Quality and Variety.

Question	1983		1984		
	X	N	X	N	t
Quality of the food	4.84	103	4.73	93	1
Variety of food at a single meal	4.88	104	4.78	93	1
Variety of the menu over the last 2 weeks	4.74	100	4.30	89	-2.0*

*Significant based on a 95 percent confidence level.

V. ECONOMIC ANALYSIS

An economic analysis of NAFSR was prepared in order to evaluate the economic feasibility of the system. In accordance with generally accepted economic analysis standards, the maximum economic life for automated data processing equipment is 8 years. The fixed costs of the NAFSR equipment are listed in Table 10. It should be noted that the NAFSR computer system equipment lised in Table 10 will certainly be required. However, the meal card production equipment will not be required since a new DoD ID card will be used in lieu of the magnetic stripe card. In this case, the magnetic stripe card readers in the dining facilities would read the DoD ID card and verify the person's SSN against the central meal card file in the main computer. When a new person arrives on base, instead of obtaining a meal card from his unit, he would have his unit notify the Food Service Office to input his SSN and other pertinent information into the central meal card file.

TABLE 10. NAFSR Fixed Costs (Ashore).

I.	NAFSR Computer System	Cost
	1 – Microcomputer (Durango F-85)*	$29,445
	2 – Electronic Cash Registers (Data Terminal System Model #521)*	$18,128
	2 – Electronic Data Terminals (Decwriter III's)	$ 4,480
	2 – Uninterruptable Power Supplies (UPS)	$ 1,900
	Subtotal:	$53,953
II.	Meal Card Production Equipment	
	1 – Camera Equipment	$ 4,000
	1 – Film and ID Cards	$ 7,500
	1 – Meal Card Encoder (Magtek #MT50)	$ 2,000
	1 – Meal Card Tipper	$ 703
	Subtotal:	$14,203
III.	Installation of Communications Cabling	
	One time labor cost Subtotal:	$ 3,750
	Grand Total:	$71,906

*Not counting a discount of as much as 40% when purchased in quantity from the GSA Schedule.

FIXED COSTS

The fixed costs that were included in this economic analysis, which are displayed in Tables 10 and 11, include the cost of the microcomputer located in the Food Service Office, the electronic data terminals in the Leading Chief's Office and the Food Service Record Keeper's Office, and the electronic cash registers and magnetic stripe card readers placed on the serving lines in the dining facilities as well as the communications equipment required for real-time processing. The cost of this equipment is $53,953. There is a one-time cost for installation of communication cabling of $3,750. The total investment costs are $57,703.

TABLE 11. NAFSR Fixed Costs (Afloat).

I. NAFSR Computer System   Cost

	Cost
1 - Microcomputer (Durango F-85) (Model 911 with two 5-1/4 Winchester hard disks)	$19,260
4 - Poppy Stations CRT	$ 5,180
4 - Okidata Printers	$ 4,000
1 - Spare Parts Kit	$ 6,789
1 - Uninterruptable Power Supply	$ 950
Subtotal:	$36,179

II. NAFSR Communications Equipment

8 - INMAC Line Drivers	$ 1,440
4 - Communications cables to the terminal areas, FSO, Wardroom, CPO Mess, and Stateroom	
NOTE: This cabling was done by shipyard personnel at Bremerton NSY.	N/C
Subtotal:	$ 1,440
Grand Total:	$37,619

NOTE: The Navy DS personnel will provide maintenance for the NAFSR hardware that is installed on the USS Constellation CV-64.

ANNUAL COSTS

The annual cost of operating NAFSR are presented in Table 12 and includes maintenance for NAFSR hardware and supplies such as floppy diskettes and computer paper. The annual cost is $9,329.

TABLE 12. NAFSR Variable Costs (Ashore).

Annual Costs

Maintenance Costs		Costs
Microcomputer		$3,996
Electronic Cash Registers		$2,136
Electronic Data Terminals		$ 900
	Subtotal Maintenance Costs:	$7,032

Supplies

Floppy Diskettes	365 @ $4.65	$1,697
Paper		$ 600
	Subtotal Supply Costs:	$2,297
	Grand Total:	$9,329

COST/BENEFIT

The cost analysis presented in Table 13 shows that NAFSR generates a cost savings over the expected life (8 years) of the system. As shown in Table 13, the present value of the total annual reduction of food service system costs is $536,058, which is generated by lower meal card abuse and associated meal cost savings. NAFSR cost savings are estimated from a reduction in the rate of questionable signature sheet entries and inaccurate records from 23% to 1%. To calculate this cost the following equation is used:

Annual cost savings per meal =

% fewer meals provided at Government expense (23 - 1 = 22)

Times ration credit per meal

Times Basic Daily Food Allowance

Times average number of meals served

Times number of days per year (365)

27

The calculations are as follows:

Breakfast
ACS = .22 X .2 X 3.85 X 255 X 365 = $15,767

Lunch
ACS = .22 X .4 X 3.85 X 369 X 365 = $45,631

Dinner
ACS = .22 X .4 X 3.85 X 278 X 365 = $34,378

Annual Cost Savings Total: $95,776

TABLE 13.   NAFSR Economic Analysis--Value of NAFSR Costs and Savings.

Costs	Present Value
Equipment Purchase	$ 53,953
Annual Expenditure for Maintenance and Supplies = $9,329 X (5.597)*	= $ 52,214
Total Present Value of Costs	$106,167
Savings	
Annual Reduction for expenses** = $95,776 X (5.597)* = $536,058	
Total Present Value of Savings	$429,891

*Present value factor of a cumulative uniform series.

**See the Annual Cost Savings calculation on following page.

This is partially offset by the increased costs resulting from equipment purchase and annual maintenance and supply costs. Overall, a net present value of $429,891 in savings results from the implementation of NAFSR. Further, as shown, NAFSR is cost-effective even when only considering the cost savings that were quantifiable in this limited evaluation. For example, the NAFSR assisted food service personnel in controlling food costs. If food savings are achieved, however, instead of direct cost savings resulting, the staff modifies the menu to serve more expensive food items so that, on average, the full Basic Daily Food Allowance is expended. This is a direct benefit to service members because a more expensive and high quality food item may be served more often. However, it does not result in a quantifiable cost savings, and therefore, it is not included in this analysis.

The cost savings in the afloat test, although not as quantifiable as the ashore version, are nevertheless substantial. These cost savings will be in the areas of reduced time to prepare food preparation worksheets, breakout documents, tighter inventory control, and, in general, more flexibility in managing what is served and when by the food service staff.

INVESTMENT PAYBACK SUMMARY

The internal rate of return or capital recovery rate is in excess of 300%. This is based on the cumulative mid-year discount factor of .667 that results when comparing project costs of $57,703 to the average annual net savings of $86,447 (see Tables 14 and 15). The cumulative mid-year discount factor is also equivalent to the amortization rate of .667 years or 8 months (see Table 15).

The present value savings to investment ratio is equal to 8,385 (Table 15). This is based on the comparison of the cumulative present value savings to the initial investment, using an economic life of 8 years.

These savings could be equated to man-year spaces (Table of Distribution and Allowances) by converting dollars into reduced food preparation worksheet and breakout documents labor.

TABLE 14. Investment Payback Analysis (Ashore Alternative).

Equipment Title: NAFSR Computer System

Useful Life of Equipment: 8 years

Total Investment		Dollars
A.	Equipment Cost (Purchase)	53,953
B.	Installation/Start-Up Cost	3,750
C.	Total (A+B)	57,703

Annual Operating Costs		
D.	Average Annual Admin Cost	0
E.	Maintenance/Repair and Supplies	9,329
F.	Total (D+E)	9,329

Annual Cost Savings		
G.	Annual Savings	95,776

Net Annual Savings		
H.	(G-F)	86,447

TABLE 1   Investment Payback Summary (Ashore Alternative).

Internal Rate of Return (IRR)	Dollars
A. Project Costs	$57,703
B. Average Annual Savings (Net)	86,447
C. Cumulative Mid-Year Discount Factor (A-B)	0.667
D. % IRR (Table H-3, App H, CA 5, AR 5-4)	300+

Savings to Investment Ratio (S-I)

E. Average Annual Net Savings	86,447
F. 8 Year Cumulative 10% Discount Factor	5,597
G (E x F)	483,844
H. Project Investment Costs	57,703
I. Present Value Savings/Investment (G-H)	8,385

(Optional)
*Rate of Investment Per Manpower Spaces Saved (RIMS)

J. Project Costs (A or H)	57,703
K. RIMS (J-K)	N/A

Amoritization Years/Months

L. Project Costs (A or H or J)	57,703
M. Average Annual Savings (Net)	86,447
N. (L-M)	0.667 yrs
	or 8 months

VI. SUMMARY AND RECOMMENDATIONS

The test of the NAFSR conducted at NAS Alameda clearly indicates that automating Navy food service is not only feasible but also cost-effective. There were both quantitative and qualitative benefits derived from the NAFSR. The automated headcount data indicates a significant reduction in meal card abuse from 23% to 1%. The more qualitative benefits resulted from food service personnel performing more useful tasks (i.e., the managers being able to concentrate on managing the operation of the dining facility and spending less time on manual calculations and report preparation).

There must be one central coordinating, authorizing activity in the Navy to prevent duplication of effort and the confusion that may result from too loose a controlling element. It is strongly recommended that NAVFSSO hire, transfer, or delegate responsibility for the coordination of and Navy-wide implementation of NAFSR to a central activity with Natick acting in a supporting role. This activity would have the responsibility for trouble report identification, system change packages, and updates of NAFSR, as well as the distribution and coordination thereof.

The economic analysis of the NAFSR implementation at NAS Alameda indicates that NAFSR is cost-effective when compared to the problem areas cited by GAO and DAS audits. Considerable annual savings ($95,776) can accrue from the increase access control/automated headcount system. It is therefore recommended that the NAFSR be implemented throughout the Navy.

The NAFSR software was undergoing constant streamlining and modification during the test effort in the ashore as well as the afloat environments. The documentation is being revised to agree with the NAFSR user guides and file descriptions. This documentation will soon be available for all levels of the Navy.

APPENDIX A.

Data Collection Forms

DATE _____   WORK LOCATION _____

TIME (15 MIN)	JOB CATEGORY			TIME (15 MIN)	JOB CATEGORY				
	1	2	3		1	2	3		
								CODE (COL.1)	
							AT WORK LOCATION	1	
							AWAY FROM WORK LOCATION	2	

ACTIVITY	CODE (Col. 2 & 3)
Preparation	01
Cooking	02
Service	03
Sanitation	04
Supply	05
Administration	06
Maintenance	07
CIT	08
Supervision	09
Absent	
-Product in Prep	11
-Del/Serv Prod	12
Other Productive	13
Recpt. Prep -N.S.F 335	20
-N.S.F 335	21
-N.S.F 357	22
-N.S.F 1046	23
-N.S.F 1050	24
-N.S.F 1059	25
-N.S.F 1155	26
-N.S.F 1282	27
-N.S.F 1292	28
-N.S.F 1336	29
-N.S.F 1340	30
-N.S.F 1357	31
-N.S.F 1358	32
Other Rcpt	33
Non-Productive	
Cannot be Paid	40
Dev Out of Galley	41
Miscellaneous	42

34.

JOB ACTIVITY DIARY

I. ## Specific Job Activity

Code   Description

01   Preparation - The obtaining, mixing,
              cutting, chopping, etc., of all ingredients
              used for salads, meat, and vegetable
              production. The general preparation of all
              food products.

02   Cooking - All actual activities involved in
              the art of cooking. For example, selecting
              proper temperature setting, monitoring food
              being cooked or reconstituted, seasoned,
              placing and removing food from containers,
              cooking food on grill or oven.

03   Serving - This activity is related to
              activities associated with the serving line
              outside the purview of "cooking" These
              include plating meals, setting up and breaking
              down serving line, and replenishing the line.
              This also includes the time spent in position
              ready to serve even though there are no
              customers.

04   Sanitation - This encompasses all aspects of
              cleaning, trash disposal, and sanitation in
              all food service areas. For example,
              dishwashing, pot and pan washing, the placing
              of these wares into their proper receptacles,
              and equipment sanitation.

05   Supply - This includes the movement of
              supplies from the storage area as well as
              receiving, unpacking, etc., of these supplies
              from outside sources. All inventory
              manipulation, internal issuance of supplies,
              and replenishment of all beverage equipment.

06   Administration - This includes the drafting
              and typing of correspondence and the
              maintenance of civilian employee personnel,
              and pay records. This category includes
              answering the telephone and paging personnel
              as well as changing menu boards for upcoming
              meals. This does not include supplying a
              demonstration or report preparation.

Code	Description

07   <u>Maintenance</u> - Preventative or corrective maintenance done on any piece of equipment necessary for the completion of the food service mission. This category includes burner maintenance.

08   <u>On-The-Job Training</u> - This task involves knowledge and/or skills being taught to an individual in a planned, structured manner. The observer should look for demonstrations, explanations, practice sessions, and self-instructional activities.

09   <u>Supervision</u> - This includes review of the present system by Supervisor in procedures and methods, as well as inspection and monitoring of food service areas/personnel, including giving instructions.

10   <u>Traveling</u> - This includes driving or being in transit from one work location to another.

11   <u>Picking Up/Delivering Supplies</u> - This includes the acquisition of supplies which may include food or expendables (paper products, office supplies, etc.) for use at the work location.

| DATE _____ | DINING FACILITY _____ | MEAL ____ |

No Card	Card	TIME START m m s s	TIME FINISH m m s s	No Card	Card	TIME START m m s s	TIME FINISH m. m s s

NAS ALAMEDA - WORK SAMPLING STUDY
MAY 10-26 1903

DAY OF WEEK (MONDAY = 1, SUNDAY = 7)

SILO

MO DAY

FAC

TIME
HH MM

ECR - ARRIVAL RATE

TIME PERIOD _____

DATE _____ DINING FACILITY _____ MEAL _____

TIME			
M	M	S	S

TIME			
M	M	S	S

REPORT PREPARATION

Code			Report Preparation
20	NAVSUP	335	Subsistence Ledger
21	NAVSUP	338	EDF Control Record
22	NAVSUP	367	Record of Receipts and Expenditures
23	NAVSUP	1046	Sale of General Mess Meals
24	NAVSUP	1090	Food Preparation Worksheet
25	NAVSUP	1059	Food Item Report
26	NAVSUP	1155	Order for Supplies of Services
27	NAVSUP	1282	Food Item Request/Issue Document
28	NAVSUP	1292	Recapituation of Meal Record
29	NAVSUP	1336	Requisition Log
30	NAVSUP	1340	Special Meals Report
31	NAVSUP	1357	Ration and Sales Report
32	NAVSUP	1358	EDF Operating Statement
33	Other Forms		

NAS ALAMEDA WORK SAMPLING

JOB CLASSIFICATION	CODE (Col. 1)	ACTIVITY	CODE (Col. 2 & 3)
Food Service Officer	1	Preparation	01
Records Keeper (Accountant)	2	Cooking	02
Leading Mess Management Spec (F.S. Superintendent)	3	Serving	03
Galley Captain (D.H. Supervisor)	4	Sanitation	04
Watch Captain (Assist D.H. Super)	5	Supply	05
Master at Arms (RIK Validator)	6	Administration	06
Jack-of-the-Dust (All Store Room Personnel)	7	Maintenance	07
Mess Specialist (Cooks)	8	OJT	08
Contractor (ECP Operator)	9	Supervising	09
		Absent	
		–Picking up Sup	11
		–Del/Serv Food	12
		Other Productive	13
		Report Prep –NA.SUP 335	20
		–NA.SUP 338	21
		–NA.SUP 367	22
		–NA.SUP 1046	23
		–NA.SUP 1090	24
		–NA.SUP 1059	25
		–NA.SUP 1155	26
		–NA.SUP 1282	27
		–NA.SUP 1292	28
		–NA.SUP 1336	29
		–NA.SUP 1340	30
		–NA.SUP 1357	31
		–NA.SUP 1358	32
		Other Forms	33
		Non-Productive	
		Cannot be Found	40
		Duty Out of Galley	41
		Miscellaneous	42

RIK HEADCOUNT

DATE _____   MEAL _____

CARD NO.	MEAL NO.	JUL. DATE	CARD NO.	MEAL NO.	JUL. DATE	CARD NO.	MEAL NO.	JUL. DATE	CARD NO.	MEAL NO.	JUL. DATE

APPENDIX B.

System Modules

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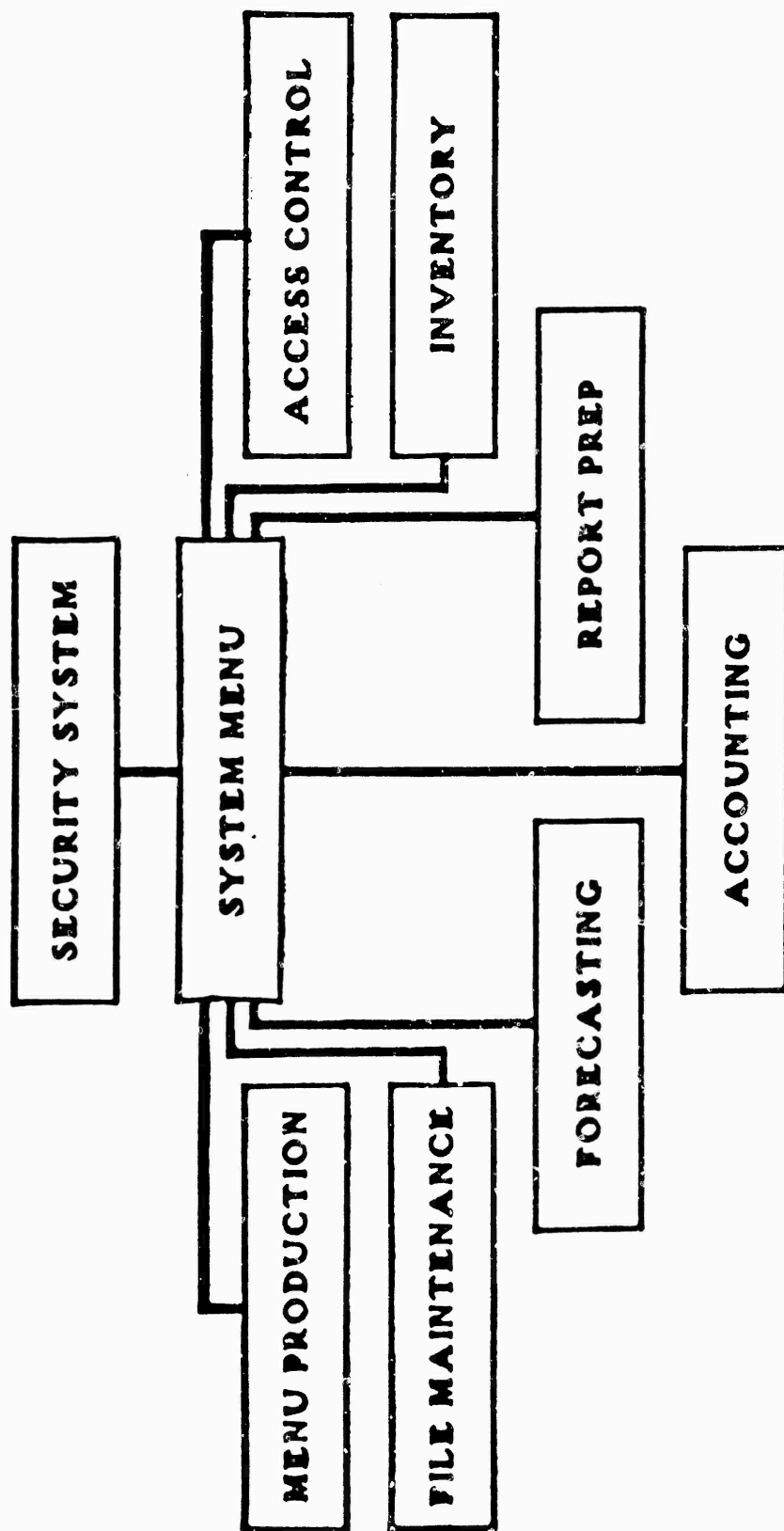## U.S. NAVY AUTOMATED FOOD SERVICE SYSTEM
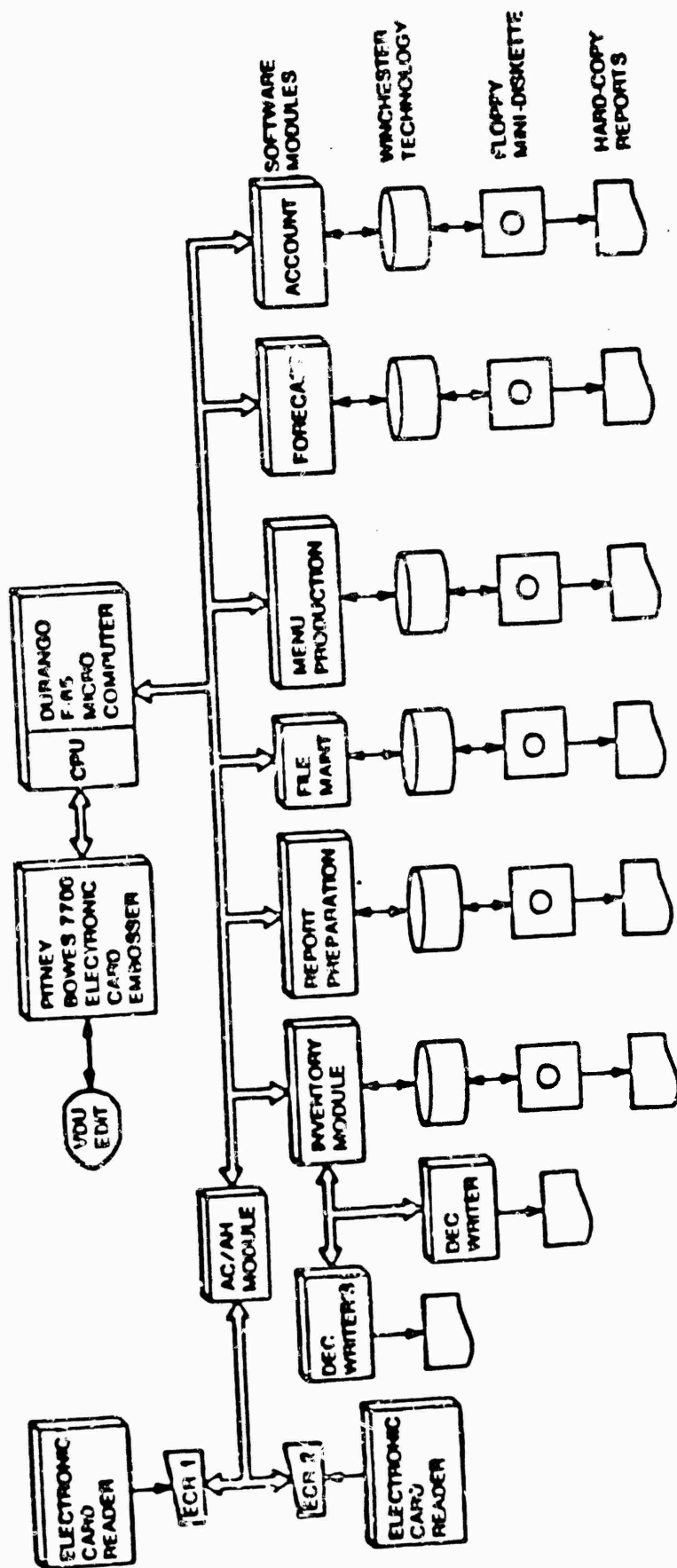

Figure B-1. US Navy automated food service system (NAFSR) modules.

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Figure B-2. NAFSR module relationships.